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ll and Sara K. Conrad, Editors

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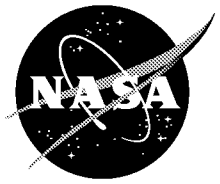

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Sara K. Conrad, Editors

Volume 219

BOREAS TGB-1 NSA CH_4 and CO_2 Chamber Flux Data

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University of New Hampshire, Durham

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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BOREAS TGB-1 NSA CH_4 and CO_2 Chamber Flux Data

Patrick M. Crill, Ruth K. Varner

Summary

The BOREAS TGB-1 team made methane (CH_4) and carbon dioxide (CO_2) dark chamber flux measurements at the NSA-OJP, NSA-OBS, NSA-BP, and NSA-YJP sites from 16-May-1994 through 13-Sep-1994. Gas samples were extracted approximately every 7 days from dark chambers and analyzed at the NSA lab facility. The data are provided in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TGB-01 NSA CH_4 and CO_2 Chamber Flux Data

1.2 Data Set Introduction

Chamber flux measurements were taken at the Northern Study Area (NSA) Old Jack Pine (OJP), Young Jack Pine (YJP), Old Black Spruce (OBS), and Beaver Pond (BP) sites during the summer of 1994 by the BOReal Ecosystem-Atmosphere Study (BOREAS) Trace Gas Biogeochemistry (TGB)-01 team. The values represent the average/mean flux from five values taken at 20-minute intervals.

1.3 Objective/Purpose

The purpose of these measurements was to examine the trace gas exchange between the atmosphere and the boreal soils.

1.4 Summary of Parameters

CH_4 and CO_2 chamber fluxes were measured at the NSA OJP, YJP, OBS, and BP sites. Temperatures of the chamber, 1-cm soil depth, and 10-cm soil depth were recorded at the OJP, YJP, and OBS (Patrick Crill) sites. At the OBS (Dean Moosavi) and BP sites, temperatures at 5-, 10-, and 20-cm soil depths were recorded.

1.5 Discussion

The chamber flux data are provided in American Standard Code for Information Interchange (ASCII) comma-delimited text files. The data are a compilation of measurements from the aluminum chamber and collar sites at OJP, YJP, and OBS (Patrick Crill) and the plastic chamber and collar sites at OBS (Dean Moosavi) and BP sites. Another part of the data is a diurnal study completed 08-Jul-1994 and 09-Jul-1994 at the BP plastic collar and chamber sites.

1.6 Related Data Sets

BOREAS TGB-01 CH4 Tower flux data over NSA
BOREAS TGB-01 Soil CH4 and CO2 concentration data over the NSA

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Patrick M. Crill
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University of New Hampshire

2.2 Title of Investigation

Magnitude and Control of Trace Gas Exchange in Boreal Ecosystems

2.3 Contact Information

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3. Theory of Measurements

Chamber fluxes measure the changes in the mixing ratio of trace gases (CO_2 and CH_4) in a closed headspace over a period of time. This headspace is isolated from the atmosphere; therefore, the exchange of material between the covered soil and the headspace can be quantified.

4. Equipment

4.1 Sensor/Instrument Description

CH_4 was quantified with a Shimadzu GC-14A Gas Chromatograph (GC) or a Shimadzu GC-MINI2 with a flame ionization detector (FID) operated at 125 °C after separation on a HayeSepQ column at 40 °C using ultrapure (99.999%) N_2 as a carrier gas flowing at 30 mL/min. CO_2 was quantified with a Shimadzu GC-14A with a thermal conductivity detector (TCD) operated at 70 °C after separation on a HayeSepQ column at 40 °C using ultrapure (99.999%) He as a carrier gas flowing at 30 mL/min. The oven temperature during sample analysis was run at 130 °C and the detector at 300 °C. Analog signals (0-1 V) from the detectors were digitized at 10 Hz with a Hewlett Packard (HP) 35000D A/D board and quantified and logged using HP ChemStation software. Chamber fluxes were accomplished with aluminum chambers manufactured at the University of New Hampshire and designed by Patrick Crill.

4.1.1 Collection Environment

The chamber fluxes were collected under ambient conditions. The GC analysis was completed at the Hayes Road Lab in Thompson, Manitoba.

4.1.2 Source/Platform

Ground.

4.1.3 Source/Platform Mission Objectives

The mission objective was to determine the soil-surface exchange rates of CH_4 and CO_2 at the NSA OJP, YJP, OBS, and BP sites.

4.1.4 Key Variables

The key variables measured during the sampling period were CH_4 and CO_2 fluxes. The OBS site was divided into two different sets of data. In the SITE_COLLAR, a C denotes the OBS site where Patrick Crill measured fluxes with aluminum chambers and collars. An M denotes the OBS site where Dean Moosavi measured fluxes with plastic chambers and collars. Plastic chambers and collars were also used at the BP site. Soil profile temperatures were also recorded.

4.1.5 Principles of Operation

The Shimadzu GC-14A GC is equipped with a hydrogen FID and a TCD. The FID is used to detect CH_4, while the TCD is used to detect CO_2. The FID uses a hydrogen flame in an air atmosphere to burn components as they exit the column. In the flame, carbon-carbon bonds are fragmented so that various organic ions and free electrons exist. Application of a voltage across a collector electrode over the flame causes an ion current to flow, which is amplified and then measured as the output signal.

The TCD detects CO_2 by passing a sample, in a helium carrier gas, past metallic filaments with current flowing through them. The sample components with lower thermal conductivity than the helium carrier gas raise the filament temperature when they pass through. The signal output from the TCD is a measurement of the change in filament resistance caused by the temperature rise. The signal output from both the FID and TCD is for a data processor, integrator, recorder, or computer (Instruction Manual: GC-14A; Shimadzu Corporation, Kyoto, Japan). The GC-MINI2 was equipped with a FID and operated in the same manner as the GC-14A FID.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

Manufacturer of GC-14A FID/TCD, GC-MINI2, and GC-8A ECD
Shimadzu Scientific Instruments, Inc.
7102 Riverwood Drive
Columbia, MD 21046
(410) 381-1227

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

The sensitivity of the TCD is approximately 6000 mV ml/mg. The FID's maximum sensitivity is 3 x 10^{-12} g/s for diphenyl.

4.2.2 Frequency of Calibration

The instrument is calibrated on a daily basis. Standards are run generally before and after samples on a given day of analysis.

4.2.3 Other Calibration Information

Signal peaks from the detectors were quantified with working standards calibrated against Canadian Atmospheric Environment Services (AES) certified primary standards acquired by the BOREAS project and a CO_2/CH_4 standard of Niwot Ridge air prepared by the National Oceanic and Atmospheric Administration (NOAA) Climate Monitoring and Diagnostics Laboratory (CMDL). Uncertainty in the standards' analyses on a given day ranged from 0.1 to 0.2%.

5. Data Acquisition Methods

The chamber fluxes are determined by analysis of concentrations of methane (CH_4) and carbon dioxide (CO_2) in a time series of grab samples of headspace over the ground surface enclosed by a dark aluminum chamber. The volumes of the two aluminum chambers were 0.071 and 0.120 m^3 over an area of 0.397 m^2. The aluminum chamber was placed on the trough of an aluminum collar embedded in the ground. Water was added to the trough of the collar to create an airtight seal. The volume of the plastic chambers was 0.028 m^3 over an area of 0.078 m^2. The seal between chamber and collar was made using weather stripping or water as appropriate. Five 60-mL samples were removed from the headspace with polypropylene syringes and polycarbonate/nylon stopcocks at 4-minute intervals for 20 minutes (five samples). Samples were returned to the Hayes Road lab and analyzed for CO_2 and CH_4 using gas chromatography within 12 hours after collection.

6. Observations

6.1 Data Notes

None given.

6.2 Field Notes

For data collected by Patrick Crill:

- 25-May-94- Fans in chambers not working at OBS. Can't use the data.
- 29-May-94- Fan in chamber not working after 20 minutes in OJPA2 flux; no fan for the OJPM2 flux; no fan for the OJP1 and 2 fluxes.
- 01-Jun-94- No fan for OBS12 flux.
- 20-Jun-94- Thermometer probe outside of chamber for collar OBS1.
- 10-Jul-94- One chamber had been filled with water and therefore the fan and temperature probe aren't working. Used it with collars YJP1, OJPA1, OJPL2, OJPM1, and OJPM2.
- 16-Jul-94- No temperature still in one chamber at OJP and YJP.
- 23-Jul-94- No temperature still in one chamber at OJP and YJP; Collar YJP2 syringe number 4 lost its stopcock.
- 30-Jul-94- No temperature still in one chamber at OJP and YJP.
- 01-Aug-94- Very hot, using silver mylar to reflect sun on half of the flux chambers to see if it effects temperature change in chamber...it doesn't heat up as much as chambers without cover by about 10 °C.
- 07-Aug-94- Fixed chamber thermometer for first few fluxes; then it went bad again.
- 08-Aug-94- No fan for collar OBS10 flux; no temperatures for OBS8, OBS6, OBS11, OBS4, and OBS2
- 12-Aug-94- No temperature still in one chamber at OJP and YJP.
- 19-Aug-94- No temperature still in one chamber at OJP and YJP.

For data taken by Dean Moosavi:

- 19-May-94- Experiments halted due to chamber hardware problems.
- 20-May-94- Screw missing in chamber for flux at collar OBS1; therefore, there was a hole in chamber during the flux. Fixed with duct tape.
- 26-May-94- Problems with collar at collar BP29.
- 04-Jun-94- Water levels in the fen have dropped 5-10 cm from season beginning at OBS.
- 10-Jun-94- Carex and other vegetation have sprouted. Larch are out.
- 20-Jun-94- Temperature probe dead!
- 21-Jun-94- Fans did not work for collars 19 and 20 at BP.
- 30-Jun-94- BP- Bear attack on equipment! Collar 23 pulled up and moved 5 yards. Minor tooth damage. Collar 18 destroyed. Lichen thermocouple uprooted and destroyed. Pond and dam level have dropped 10 cm leaving collars above the water level.

- 02-Aug-94- BP- Moose stepped in collar 24!
- 21-Aug-94- Senescence beginning.
- 24-Aug-94- Due to problems with yesterday's samples. BP and dam were resampled off collar in vicinity of site.
- 31-Aug-94- BP and dam fluxes taken next to (NOT on) collars.
- 13-Sep-94- BP collars 25-32 fluxes taken near (not on) collars.
- 14-Sep-94- All collars and chambers removed!

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

Descriptions of the sites and their North American Datum of 1983 (NAD83) coordinates are:

- The collars at the OJP tower site and profile sampling sites were located on moss plots that were approximately northwest of the tower, while the profile corral was located a few meters south of the collars (55°55'43.2" N, 98°37'29.4" W).
- The collars at the OJP site located on lichen plots were due west of the tower; the profile trench was located about 1 m southeast of the collars (55°55'40.9" N, 98°37'29.3" W).
- The collars at the YJP tower site were located southeast of the tower; the gas profile corral was located approximately 1 m west of the collars (55°53'42.8" N, 98°17'12.7" W).
- The collars at the OBS tower site were located along a low to high moisture gradient from the lichen to the feathermoss, the fen rim, and ending at the fen site. The lichen and the feather moss collars were located along the boardwalk approximately 200 m northeast of the tower. The fen rim and fen site collars were located due east of the lichen and feather moss sites about 150 m and 200 m respectively.

For data collected by Dean Moosavi:

- The collars and profile sampling sites near the OBS tower were located as follows: the OBS sampling collars were located along a moisture gradient from feathermoss and lichen sites to the fen rim site and ending with the fen sites. The transect ran approximately east to west and was located about 200 m northeast of the tower at the OBS site.
- The collars and profile sampling sites at the BP tower site were located as follows: the BP sampling sites were located along a low to high moisture gradient that began with the upland lichen site, then the sphagnum moss site, the mire site, and ending at the pond site. The transect ran approximately north to south and was about 60 m from the BP tower.

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

Four collars were placed in the ground for each biome type. They were approximately 1 to 2 m apart depending on the site specifics. In Section 7.3.3, the cover type refers to the predominant vegetation in the collar. These are point source measurements at the locations given in Section 7.1.1.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Chamber fluxes were measured from 16-May-1994 through 13-Sep-1994. One diurnal study was conducted at eight collars on 08- and 09-Jul-1994 at the BP site.

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

The chamber fluxes were measured approximately every 7 days from 23-May-1994 to 20-Sep-1994.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
CO2_FLUX
CH4_FLUX
COVER_TYPE
SOIL_TEMP_1CM
SOIL_TEMP_5CM
SOIL_TEMP_10CM
SOIL_TEMP_20CM
COLLAR_ID
CO2_CONC
CO2_CONC_2
CH4_CONC
CH4_CONC_2
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, or TRN; TTT identifies the cover type for the site (999 if unknown); and CCCCC is the identifier for site (exactly what it means will vary with site type).
SUB_SITE	The identifier assigned to the subsite by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the subsite instrument (e.g., HYD06 or STAFF), and IIIII is the identifier for the subsite, (often this will

	refer to an instrument).
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
CO2_FLUX	Carbon dioxide flux.
CH4_FLUX	Methane flux.
COVER_TYPE	The dominant species, vegetation, or type of land cover that exists at the location.
SOIL_TEMP_1CM	Soil temperature at 1-cm depth.
SOIL_TEMP_5CM	Soil temperature at 5-cm depth.
SOIL_TEMP_10CM	Soil temperature at 10-cm depth.
SOIL_TEMP_20CM	Soil temperature at 20-cm depth.
COLLAR_ID	A TGB-01 designation for the chamber collar sites, in the form of A-BBB-##, where A = C or M (Crill or Moosavi), BBB denotes the site and possibly microtopographic designation, and ## is a sequention collar number.
CO2_CONC	CO2 concentration.
CO2_CONC_2	CO2 concentration.
CH4_CONC	CH4 concentration.
CH4_CONC_2	CH4 concentration.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are Checked by PI (CPI), Certified by Group (CGR), Preliminary (PRE), and CPI but questionable (CPI-???).
REVISION_DATE	The most recent date that the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
CO2_FLUX	[micromoles][meter-2][second-1]
CH4_FLUX	[micromoles][meter-2][second-1]
COVER_TYPE	[none]
SOIL_TEMP_1CM	[degrees Celsius]
SOIL_TEMP_5CM	[degrees Celsius]
SOIL_TEMP_10CM	[degrees Celsius]
SOIL_TEMP_20CM	[degrees Celsius]
COLLAR_ID	[none]
CO2_CONC	[parts per million]
CO2_CONC_2	[parts per million]
CH4_CONC	[parts per million]
CH4_CONC_2	[parts per million]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	Not applicable
SUB_SITE	Not applicable
DATE_OBS	Investigator
TIME_OBS	Investigator
CO2_FLUX	Calculated by investigator
CH4_FLUX	Calculated by investigator
COVER_TYPE	Determined by investigator
SOIL_TEMP_1CM	Thermocouple
SOIL_TEMP_5CM	Thermocouple
SOIL_TEMP_10CM	Thermocouple
SOIL_TEMP_20CM	Thermocouple
COLLAR_ID	Thermocouple
CO2_CONC	Shimadzu GC-14A
CO2_CONC_2	Shimadzu GC-14A
CH4_CONC	Shimadzu GC-14A
CH4_CONC_2	Shimadzu GC-14A
CRTFCN_CODE	Shimadzu GC-14A
REVISION_DATE	Shimadzu GC-14A

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-BVP-FLXTR	NSA-YJP-FLXTR	None	None	None	None
SUB_SITE	TGB01-FLX01	TGB01-FLX01	None	None	None	None
DATE_OBS	16-MAY-94	13-SEP-94	None	None	None	None
TIME_OBS	0	2316	None	None	None	None
CO2_FLUX	-3.9236111	10.6365741	-999	-888	None	None
CH4_FLUX	-0.0062153	2.4537037	-999	-888	None	None
COVER_TYPE	N/A	N/A	None	None	None	None
SOIL_TEMP_1CM	1	40.3	-999	None	None	Blank
SOIL_TEMP_5CM	2.8	28.4	-999	None	None	Blank
SOIL_TEMP_10CM	-1	23.1	-999	None	None	None
SOIL_TEMP_20CM	-1.9	99.7	-999	None	None	Blank
COLLAR_ID	C-OBS-01	M-OBS-w-16	None	None	None	None
CO2_CONC	363.5	472.5	None	None	None	Blank
CO2_CONC_2	364	504.3	-999	None	None	Blank
CH4_CONC	1.945	2.319	None	None	None	Blank
CH4_CONC_2	2.066	2.262	-999	None	None	Blank
CRTFCN_CODE	PRE	CPI	None	None	None	None
REVISION_DATE	23-AUG-96	14-JAN-97	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the

```
                      parameter value, but the attempt was unsuccessful.
Unrel Data Value    -- The value that indicates unreliable data.  This is used
                      to indicate that an attempt was made to determine the
                      parameter value, but the analysis personnel deemed the
                      value to be unreliable.
Below Detect Limit -- The value that indicates parameter values below the
                      instrument's detection limits.  This is used to
                      indicate that an attempt was made to determine the
                      parameter value, but the analysis personnel determined
                      that the parameter value was below the detection
                      limit of the instrumentation.
Data Not Cllctd     -- This value indicates that no attempt was made to
                      determine the parameter value.  This usually
                      indicates that BOREAS Information System (BORIS) staff
                      combined several similar but not identical data sets into
                      the same data base table but this particular science team
                      did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A   -- Indicates that the value is not applicable to the respective column.
None  -- Indicates that no values of that sort were found in the column.
```

7.4 Sample Data Record

The following are wrapped versions of data records from a sample data file on the CD-ROM.

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,CO2_FLUX,CH4_FLUX,COVER_TYPE,SOIL_TEMP_1CM,
SOIL_TEMP_5CM,SOIL_TEMP_10CM, SOIL_TEMP_20CM, COLLAR_ID,CO2_CONC,CO2_CONC_2,
CH4_CONC,CH4_CONC_2,CRTFCN_CODE, REVISION_DATE
'NSA-BVP-FLXTR','TGB01-FLX01',02-AUG-94,1716,-888,-888,'Mire',16.4,15.6,14.3,
'M-BP-mc-26','CPI,'13-JAN-97
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data is the CO_2 and CH_4 fluxes measured on a particular date at a particular site.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

$$R_f = C_{std}/A_{std}$$
$$C_s = R_f * A_s$$

Where: R_f = Response factor
A_{std} = Average of 10 standard peak areas
C_{std} = Concentration of the standard
C_s = Concentration of the sample
A_s = Peak area of sample

CH_4 and CO_2 concentrations were calculated from the average of 10 peak areas of known CH_4 and CO_2 standards. The response factor was calculated as the concentration of the known standard divided by the average of 10 standard peak areas. The peak area of the unknown sample was multiplied by the response factor. Fitting a regression curve to the time series of CH_4 and CO_2 concentrations made the flux calculations. The flux rate of a gas is calculated using the following equation:

$$F= ppmv/min*(P/R*MW)*1/T*V_c/A_c*C$$

Where: F = flux ($mg/m^2/d$)
P = Chamber pressure (atm)
R = 8.2054×10^{-5} m^3 atm/mol/K
MW = Molecular weight of the analyte
T = Chamber temperature (K)
V_c = Chamber volume (m^3)
A_c = Chamber area (m^2)
C = (1000 mg/g*1440 min/d)

Gases: CH_4 = 16 g/mol
CO_2 = 44 g/mol

At sites where oxidation of CH_4 occurs, the flux starts at or near ambient CH_4 concentrations and is depleted below ambient concentrations. If the correlation coefficients were not significantly high, the flux was determined to be below the detection limit and was regarded as a zero flux rate. If there was an efflux of CH_4 was measured at any of these sites, those data were eliminated.

For sites where CH_4 and CO_2 were known to have a positive flux (from the soil into the atmosphere) the regressions of the time series were expected to have an r^2 of greater than 0.85.

If -888 is present in the data set, it indicates that a measurement was taken but discarded for some reason. If -999 is present, then no data were taken.

9.1.1 Derivation Techniques and Algorithms

Not applicable.

9.2 Data Processing Sequence

Not applicable.

9.2.1 Processing Steps

The peak areas were taken directly from the HP ChemStation reports from the GC. They were entered into spreadsheets and the concentrations were calculated by the formulas in Section 9.1. The spreadsheets then automatically calculate the flux using the formulas.

9.2.2 Processing Changes
None given.

9.3 Calculations
Not applicable.

9.3.1 Special Corrections/Adjustments
Not applicable.

9.3.2 Calculated Variables
Not applicable.

9.4 Graphs and Plots
None.

10. Errors

10.1 Sources of Error
Field sampling error could account for some error in the concentration of the syringe samples:

- Not flushing the sampling line from the chamber before sampling could cause dilution of the sample with air from the last sampling time.
- Not completely closing the syringes or allowing them to come open during transport will cause dilution from ambient air.
- Placing the chamber down with much force can change the pressure inside the chamber to other than ambient and can affect the mechanisms and processes producing/taking up CH_4 and CO_2.

Errors such as these would have been written down in the lab/field books, and those data therefore would have been edited out. The analytical precision of the GCs is 0.2% for CH_4 and 1% for CO_2.

10.2 Quality Assessment

10.2.1 Data Validation by Source
None given.

10.2.2 Confidence Level/Accuracy Judgment
None given.

10.2.3 Measurement Error for Parameters
The analytical precision of the GCs is 0.2% for CH_4 and 1% for CO_2.

10.2.4 Additional Quality Assessments
Not applicable.

10.2.5 Data Verification by Data Center
Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data
See notes under Section 6.

11.3 Usage Guidance
None given.

11.4 Other Relevant Information
None given.

12. Application of the Data Set

The chamber flux data can be used in connection with the tower flux data to determine the CH_4 and CO_2 exchange between the atmosphere and the boreal soils. The soil profile data can be used in comparison with the flux data to determine controls on the fluxes for a certain biome.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description
HP ChemStation.

14.2 Software Access
HP ChemStation can be purchased from Hewlett Packard.

15. Data Access

The TGB-01 NSA CH_4 and CO_2 chamber flux data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information
For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

Instruction Manual: GC-14A. Shimadzu Corporation, Kyoto, Japan.

17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

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AES      - Atmospheric Environment Services
ASCII    - American Standard Codes for Information
BOREAS   - BOReal Ecosystem-Atmosphere Study
BORIS    - BOREAS Information System
BP       - Beaver Pond site, NSA
CD-ROM   - Compact Disk-Read-Only Memory
CGR      - Certified by Group
CMDL     - Climate Monitoring and Diagnostics Laboratory
CPI      - Certified by PI
CPI-???  - Certified but questionable
DAAC     - Distributed Active Archive Center
ECD      - Electron Capture Detector
EOS      - Earth Observing System
EOSDIS   - EOS Data and Information System
FID      - Flame Ionization Detector
GC       - Gas Chromatograph
GIS      - Geographic Information System
GMT      - Greenwich Mean Time
GSFC     - Goddard Space Flight Center
HP       - Hewlett Packard
HTML     - HyperText Markup Language
NAD83    - North American Datum of 1983
NASA     - National Aeronautics and Space Administration
NOAA     - National Oceanic and Atmospheric Administration
NSA      - Northern Study Area
OBS      - Old Black Spruce
OJP      - Old Jack Pine
ORNL     - Oak Ridge National Laboratory
PANP     - Prince Albert National Park
PRE      - Preliminary
SSA      - Southern Study Area
TCD      - Thermal Conductivity Detector
TGB      - Trace Gas Biogeochemistry
URL      - Uniform Resource Locator
YJP      - Young Jack Pine site, NSA
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The BOREAS TGB-1 team made methane (CH_4) and carbon dioxide (CO_2) dark chamber flux measurements at the NSA-OJP, NSA-OBS, NSA-BP, and NSA-YJP sites from 16-May-1994 through 13-Sep-1994. Gas samples were extracted approximately every 7 days from dark chambers and analyzed at the NSA lab facility. The data are provided in tabular ASCII files.

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